

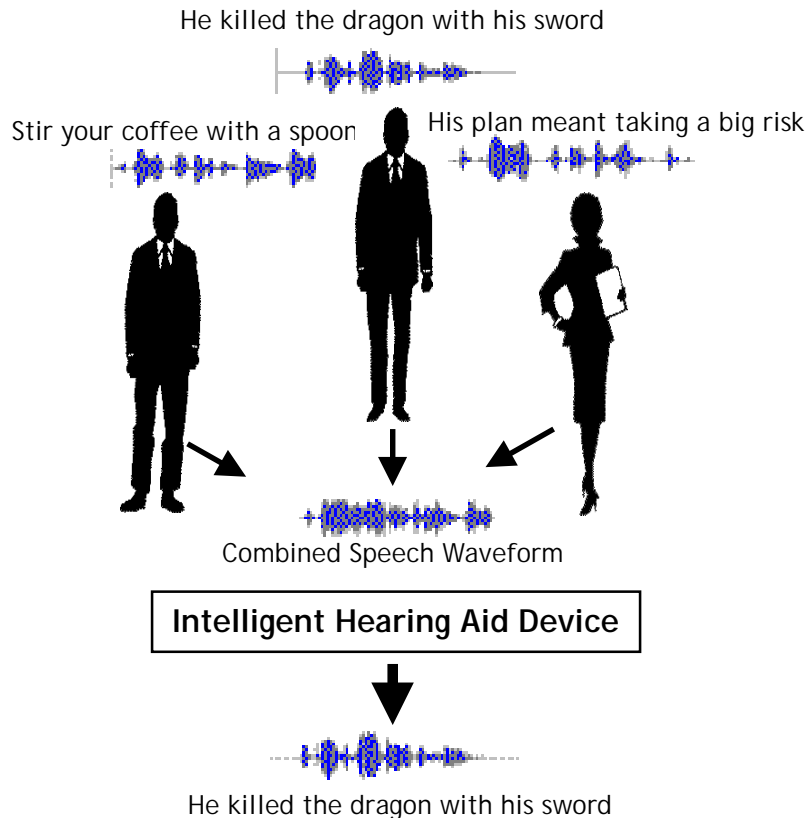


Intelligent Hearing Aid Project

Beckman Institute
University of Illinois at Urbana-Champaign

Douglas Jones

Collaborators: C. Liu, A. Feng, B. Wheeler,
W. O'Brien, C. Lansing, R. Bilger



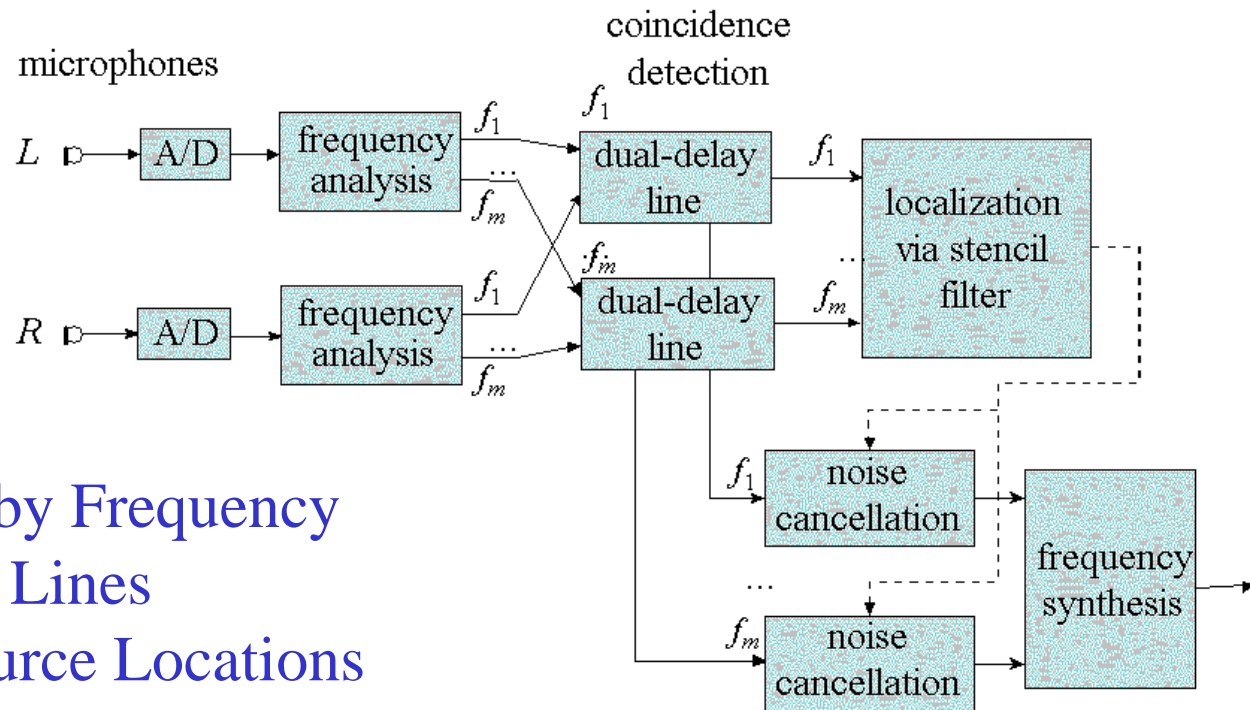
Goal:

Develop high performance auditory processors which can effectively extract a desired speech signal in the presence of multiple competing sounds.

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Algorithm 1:

Localization and Cancellation

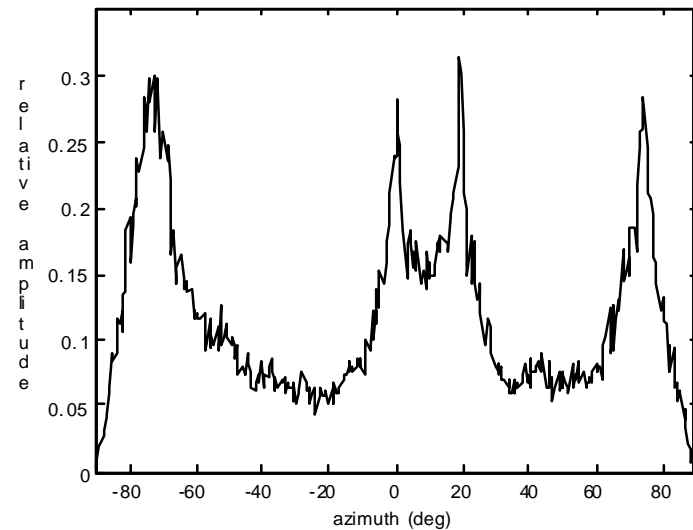
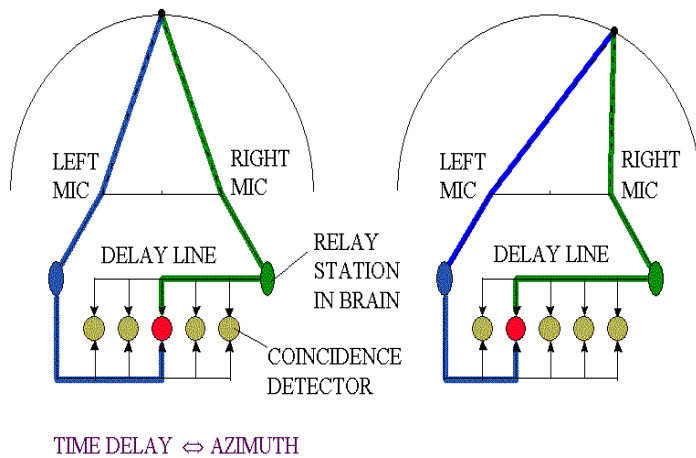


- Separation by Frequency
- Dual Delay Lines
- Identify Source Locations
- Cancel Noise by Steering Nulls



Algorithm 1:

Localization and Cancellation



Localization in the Brain

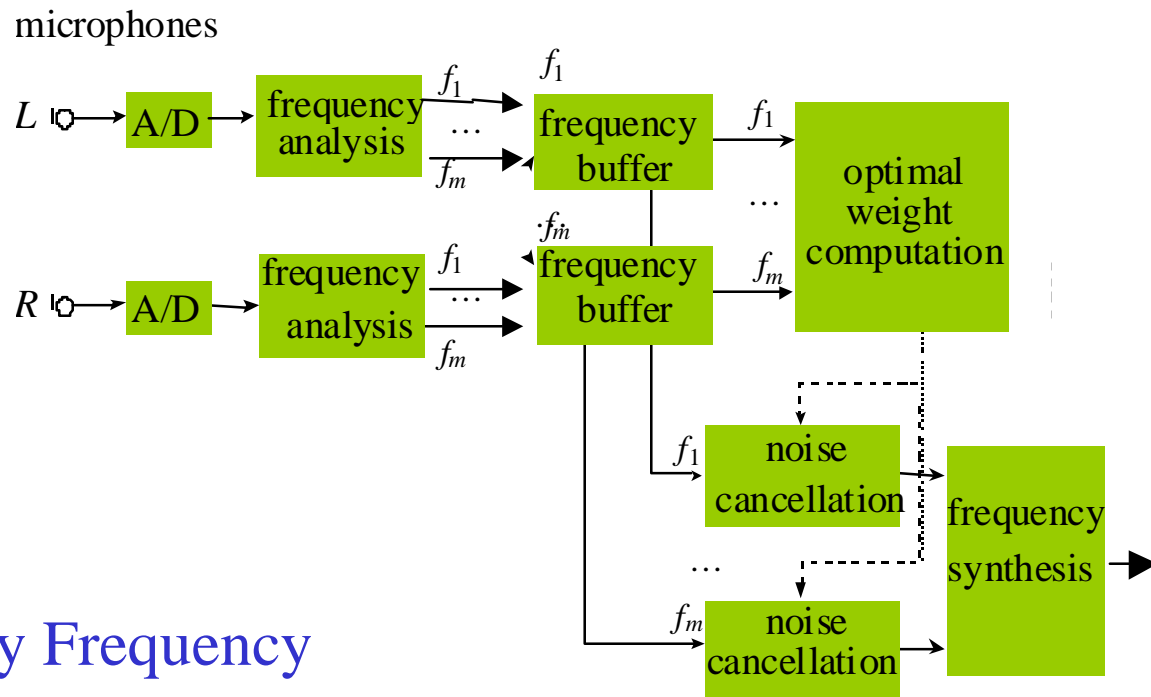
Localization by Computer
(measure of coincidence vs. azimuth)



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Algorithm 2:

Minimum Variance Cancellation



- Separation by Frequency
- Minimize Off-Axis Signal Strength



Experimental Examples

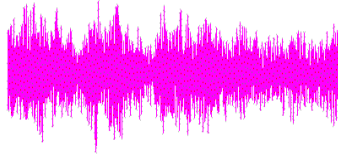
The old train was powered by steam

Target
@ 0°



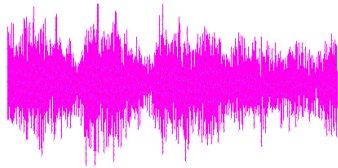
Interferor
@ 65°

Twelve talker babble



Interferor
@ 30°

Target
@ 0°



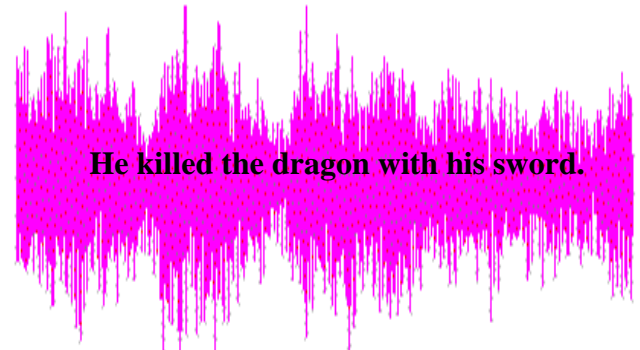
Combined
Waveform

Interferor
@ 22°

Reconstructed
Waveform



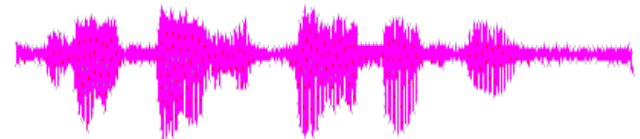
Stir your coffee with a spoon. Stir your



He killed the dragon with his sword.

His plan meant taking a big risk. His pl

Combined
Waveform



Reconstructed
Waveform



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Experimental Summary

(ALGORITHM 2)

| Expmnt # | Position Attenuation | Position Attenuation | Position Attenuation | Position Attenuation | Average Gain |
|----------|-------------------------|-------------------------|-------------------------|-------------------------|-----------------|
| 1 | -75° 4.8 dB | Target: 0° 0.6 dB | 20° 4.1 dB | 75° 2.1 dB | 6.2 dB |
| 2 | 30° 6.3 dB | -45° 4.2 dB | 60° 3.1 dB | Target: -10° 0.6 dB | 6.7 dB |
| 3 | Target: 10° 1.1 dB | -80° 3.9 dB | -50° 2.9 dB | 45° 2.7 dB | 4.6 dB |
| 4 | -30° 6.3 dB | 15° 0.9 dB | Target: 5° 0.9 dB | -60° 3.6 dB | 5.3 dB |
| 5 | -25° 5.7 dB | Target: 25° 0.7 dB | -70° 4.3 dB | 80° 2.9 dB | 6.3 dB |

Recordings made in a Conference Room

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Current and Future Work

- **Real-Time Implementation**
- **Microphone Compensation**
- **Dereverberation**

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